1102-138 Intracardiac Echocardiographic Quantification of Atrial Wall Thickness Changes Associated With Radiofrequency Ablation

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Purpose: To characterize the degree (ΔTHK) and rate of atrial wall thickening subsequent to ablation using intracardiac echocardiography (ICE).

Methods: ICE (9 MHz) imaging guided catheter ablations in the right (RA) and left atrium (LA) were performed in 7 closed chest swine (80–120 kg). Energy applications (maximal power-empiric, temperature [T] recording-passive, upto 120 sec) created 60 discrete lesions in the posterior RA, superior cava (SVC) and LA. ICE imaging wall thickness at each site (Table) was measured at baseline, and 1, 30 and 150 min post ablation.

Results:

	High RA	Middle RA	low RA	SVC	LA
Baseline (mm)	3.0 ± 1.2	2.8 ± 1.0	1.8 ± 0.8	2.0 ± 1.3	3.2 ± 1.5
1' post (mm)	5.0 ± 1.5	5.2 ± 1.4	3.9 ± 1.3	4.4 ± 1.6	5.8 ± 2.0
30' post (mm)	6.4 ± 2.3	7.0 ± 1.4	5.0 ± 1.1	7.2 ± 2.3	6.7 ± 1.5
150' post (mm)	6.8 ± 1.9	10.1 ± 3.1	-	8.5 ± 3.5	11.0 ± 5.6

At all sites, wall thickness was increased at 1' post relative to baseline and ↑ ΔTHK was maximal at the point of electrode-endocardial contact, gradually tapering on either side. At 30' and 150' post, thickening was more diffuse. ↑ ΔTHK at 1' post was significantly correlated with the maximal electrode T during lesion application ($r = 0.55$, $p < 0.0001$). At subsequent intervals, ↑ ΔTHK varied among the sites.

Conclusions: Important features of atrial wall response to lesion application: 1) distortion of endocardial contour (especially early); 2) thickening, progressive and often marked. These features may have important implications for catheter mapping and ablation of atrial arrhythmias.

1102-139 Clinical Utility of Intracardiac Echocardiography (9 MHz) During Radiofrequency Catheter Ablation in Man

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Intracardiac echocardiographic imaging (ICE) is increasingly useful in guiding complex electrophysiological procedure. We assessed the utility of ICE in 25 consecutive pts using a new 9 MHz ultrasound catheter. All pts (12 male, age 38 ± 16 years) were also undergoing percutaneous catheter mapping and ablation of a tachyarrhythmia (accessory pathway, n = 4; sinus node, n = 11, atrial tachycardia, n = 2; type I atrial flutter, n = 4; ventricular tachycardia, n = 2). Structural heart disease was present in 8 pts. During each procedure, the imaging catheter was placed in the right atrium (RA), superior vena cava, right ventricular inflow and outflow tract.

Results: In all pts, ICE identified distinct endocardial structures with excellent detail, including crista terminalis, RA appendage, fossa ovalis, caval orifices, right pulmonary vein orifices and all cardiac valves. ICE was important in identifying aberrant anatomy (Ebstein's anomaly, interventricular septal defect, atrial septal defect and lipomatous hypertrophy, torn chordae tendinae) or in detecting procedure complications (pericardial effusion, intraatrial thrombus, atrial perforation). In some pts, ICE was the primary ablation catheter guidance technique (e.g. sinus node modification). In all pts, ICE was contributory to the mapping and ablation process by guiding mapping catheters to anatomically distinct sites and/or assessing stability of the electrode-endocardial contact. ICE was also used to guide atrial septal puncture (n = 3) or RA basket catheter placement (n = 4).

Conclusions: 9 MHz ICE has significant utility during catheter ablation, including guidance of mapping/ablation catheters, identifying complex anatomy, and prompt diagnosis of cardiac complications.

1102-140 Measurement of Left Ventricular Volume Using a Right Ventricular Intracardiac Ultrasound Transducer: Experimental Validation

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Background: Intracardiac echocardiographic (ICE) transducers placed in the left ventricle (LV) can be used to measure LV volumes. ICE would be an attractive clinical tool for continuous LV function monitoring if the LV could be imaged from the right ventricle (RV) - eliminating the need for indwelling arterial catheters.

Methods: Using a modification of Simpson's rule, we calculated LV volumes obtained from short-axis images from a 9 Fr, 9 MHz intracardiac echocardiographic transducer placed in the RV of 10 excised swine hearts. Short-axis views of the LV were obtained at 0.5 cm increments from the apex to mitral annulus, by incremental withdrawal of the ICE catheter in the RV. Calculated LV volumes were compared to measured LV displacement volumes.

Results: Calculated LV volumes = 0.57 measured LV volumes 1.9; $r = 0.97$. Imaging from the RV location systematically underestimated LV volumes due to nonvisualization of the apical 1/3 of the LV, even when the ICE catheter was placed at the RV apex. However, LV volumes calculated using images obtained from an ICE catheter in the RV are linearly related to measured LV volumes.

Conclusion: LV volumes can be determined from an ICE in the RV, after correction for systematic underestimation that results from the different lengths of the two ventricles.

1102-141 Real Time 3D Echocardiography for Assessing the Atrial Septal Defect Size and Shunting: Quantitative Studies in a Chronic Animal Model

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We studied the capability of real-time 3D echocardiography for evaluating RV and LV volumes in 8 juvenile sheep which had undergone pulmonary valvulectomy, 4 of whom also had atrial septal defects. 3D echo calculated RV and LV ventricular stroke volumes (SV's) were compared to simultaneous determinations using Ao and Pa electromagnetic flow meters balanced against each other. Improved imaging on the Duke real time 3D system from a 3.5 MHz phased array transducer with approximately 2000 elements provided pyramidal volume data, 64° × 64° × 12 cm, at 22 volumes/second. Parallel slicing allowed computation of RV and LV diastolic and systolic cavity volumes and SV's were determined as the difference between them. For SV's, 13–46 ml/beat, for the RV, during 26 steady states correlation to EM SV was $r = 0.95$ with a mean difference 1.6 ± 2.4 ml/beat. For LV SV's 13.6–25.2 ml/beat, correlation was $r = 0.86$, with a mean difference of 0.8 ± 2.3 ml/beat. In addition to allowing calculation of RV-LV SV for shunt determination, unique *en face* tilted C-scan ASD views in real time were developed for imaging the size of the ASDs directly. Along with precise information about the physiology of ASDs, the accurate 3D beat to beat RV and LV SV's could be applied to precisely quantitate valvar regurgitation. Lastly, our observations could provide a new 3D-ultrasound fluoroscopic method to guide ASD closure device placement.

1102-142 Real-time Transmission of Echocardiographic Images Over High Speed Networks: Effects of Bandwidth, Cell Loss Ratio and Cell Error Ratio on Image Quality

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Background: Although transfer of archived echocardiographic images over networks for review is often adequate, real-time transmission of images allows an off-site expert to direct and focus the examination. We sought to determine the feasibility of real-time data transfer over ATM networks with various band-widths and network impairments.

Methods: Echocardiographic images were acquired at the Lewis Research Center using an ATL HDI 3000. These images were encoded using an MPEG-2 encoder and then sent to the NASA Research and Education Network (NREN) on a link capable of transmission up to 6.1 Mbps and directed to the Ames Research Center in California. There, images were decoded and directed to a viewing studio. Images were transferred at bandwidths ranging from 2–5 Mbps; network impairments were then added including cell loss ratios ranging from 1×10^{-9} to 1×10^{-3}, and cell error ratios ranging from 1×10^{-9} to 1×10^{-3}. Images were reviewed by an experienced echocardiographer at Ames and graded as good, usable, marginal, or unusable.

Results: Images were graded either clinically good or usable at all tested bandwidths. Significant image degradation was only observed at cell loss ratio or cell error ratios of 1×10^{-3}.

Conclusions: Real-time transmission of clinically useful echo images is possible utilizing a wide range of band-widths despite introduction of significant network impairments.

TUESDAY POSTER